

KATY PRICE

Department of English, Anglia Ruskin University, East Road, Cambridge CB1 1PT, UK

William Empson's poem 'Letter I' (1928–35) appears to anticipate the black hole, using the idea of a dying star from which no light escapes as a metaphor for unrequited passion. Closer inspection of the Cambridge undergraduate context in which the poem was written, along with the other source materials incorporated besides Arthur Eddington in the poem, reveals the motivation behind Empson's playful engagement with the limits of what was possible under general relativity. Empson's attempt to follow the metaphysical example of John Donne, using the new cosmology of the 1920s, led him to explore an extreme astro-physical condition that Eddington had dismissed as absurd, and that still had an uncertain scientific status in the 1930s.

'Of all the conceptions of the human mind from unicorns to gargoyles to the hydrogen bomb perhaps the most fantastic is the black hole . . . the black hole seems much more at home in science fiction or in ancient myth than in the real universe.' Kip Thorne¹

The romance of these contested objects, in literary and scientific writing, long predates John Wheeler's 1967 introduction of the term 'black hole'. A copy of Kip Thorne's article, ripped from a 1974 issue of *Scientific American*, sits among the papers of poet and critic Sir William Empson (1906–84). Empson would have been amused to read of the singular star's recent comportment. In 1928, pining after a fellow student at Cambridge, he had composed a poem comparing his unrequited affection to the excessive curvature warping spacetime around a star of great size and density – a passion separating its sufferer from the rest of the universe. By 1935 he had produced a final stanza in which the lover's condition is compared to that of a dense, dying star that is extremely hot but does not shine very brightly – a white dwarf such as our Sun is destined to become. A poignant couplet wraps up the unfortunate affair: 'Flame far too hot not to seem utter cold / And hide a tumult never to be told.'² An astute reader of popular science, Empson found romance in the curvature of spacetime and the fate of stars. This poem, entitled 'Letter I', represents his deepest engagement with the new cosmology of his day; it plays with scientific ideas that were right on the edge between authoritative explanation and speculation during the late 1920s and early 1930s. In connecting two astrophysical phenomena described by Arthur Eddington in 1927, the white dwarf and the hypothetical large dense star, Empson produced what sounds like a black hole: a dying star cut off from the rest of the universe, emitting light that will never be seen by external observers.

William Empson is best remembered for his idiosyncratic, inspired approach to literary analysis and for his puzzling poems replete with curious knowledge, passion and despair. A promising young mathematician, he completed the Cambridge mathematics degree while pursuing ever more literary interests, taking up English studies in earnest before suffering exile from Cambridge in 1929. His undergraduate

love affairs fuelled metaphysical poetry after the example of John Donne: where Donne had framed his own entanglements within a Copernican setting, Empson tried to get love working in the universe described by Eddington, Einstein's chief proponent in English. In revisiting this project we are faced with questions about the kind of knowledge poems can produce when they draw on science in the making.

Desmond Lee, a promising classics student, once turned to his friend Bill Empson and quoted a memorable philosophical line. The pair may have been taking a turn outside during a gathering, bored by company and seeking a frisson of intellectual companionship. Perhaps they gazed upward – the sky over Cambridge would have been rich enough in 1928. 'Le silence éternel de ces espaces infinis m'effraie', murmured the young philosopher. His friend the mathematical poet shattered this tranquil moment with a virulent objection to Pascal's meditation, his disagreement betraying a more than intellectual energy. Besides his liking for interstellar space Empson was developing a strong affection for his handsome friend. Accepting from an early stage that Lee was unlikely to reciprocate, Empson nonetheless composed a series of 'Letter' poems, sending a typed copy of each to his unresponsive correspondent.³

The most intriguing aspect of these Letters is not biographical, or even bisexual; it is the discovery of what could happen when scientific and ethical experience were drawn together in the 1920s. Empson's unrequited affection for a friend provided an opportunity for him to test the limits of contemporary science as a source of metaphors to live by; but this testing had some peculiar results when applied to Einsteinian themes. While 'Letter I' defies Eddington's pronouncement on the fate of massive stars, 'Letter IV' takes up a theory of stellar rotation that again runs counter to Eddington's beliefs at the time. Featuring exploding Zeppelins and alternatives to monogamy, 'Letter IV' raises even more difficult questions about love and knowledge. Yet of all the Letter poems it is the first that really stands out, its graceful lines and intent passion a fitting match for the stellar energies it draws on, themselves a subject of speculation and controversy at the time.

The poem begins coolly enough, venturing into fearful emptiness:

You were amused to find you too could
fear 'The eternal silence of the infinite
spaces,' That net-work without fish, that
mere Extended idleness, those
pointless places, Who, being
possibilized to bear faces, Yours and
the light from it, up-buoyed, Even of the
galaxies are void.

Word games and a graceful rhythm help turn the infinite spaces into a playground even as their emptiness is announced. The word 'mere', for example, used to mean sea but now connotes enclosed bodies of water; it also refers to a boundary or marker. Left hanging over the end of a line, 'mere' serves as a noun, following 'net-work', and as an adjective, qualifying 'Extended idleness'. The adjective 'mere' has reversed its meaning over time, from 'nothing less than' to 'nothing more than'; its behaviour is a

perfect miniature of the way Empson's poems unwind through shifting and contrary points of view. The perspective of this first verse, lingering over those three-syllable words and the invented 'possibilized' and 'up-buoyed', is one of relaxed and indulgent charm – given a slightly dangerous thrill when 'void' tightens up the concluding line.

It is hardly a surprise to learn of the speaker's own attitude towards space:

I approve, myself, dark spaces between stars;
All privacy's their gift; they carry glances
Through gulfs; and as for messages (thus Mars'
Renown for wisdom their wise tact enhances,
Hanged on the thread of radio advances)
For messages, they are a wise go-between,
And say what they think common-sense has seen.

Flirtation continues, with private 'glances' passing between stellar bodies – but glances can also be damaging blows. Space may carry messages, but these can get scrambled up in the process; the poem's own message about communication almost makes a nonsense of the whole verse. The speaker diverts from his point about commonsense interpretation to suggest that the reputation of Mars for hosting intelligent life is enhanced by our lack of communication with its inhabitants: we may 'hang' our hopes for this on the 'thread' of advances in radio technology, but the required breakthrough might well prove Martian life unintelligible to us (the 'hanging' of hopes lends another nasty turn to the verbal play, accentuated by the association of Mars with war). We can communicate best with the Martians of our imagination, a conclusion that does not bode particularly well for the 'common-sense' interpretation of signals between humans.

Verse three develops into radical doubt about shared understanding. As in the previous two verses this condition is enacted by the behaviour of the words themselves, which are filled with esoteric references:

Only, have we sense, common-sense in common,
A tribe whose life-blood is our sacrament,
Physics or metaphysics for your showman,
For my physician in this banishment?
Too non-Euclidean predicament.
Where is that darkness that gives light its place?
Or where such darkness as would hide your face?

In his note to the poem Empson explained that while the first verse describes 'empty space which you could measure', in verse three he was establishing an opposite condition, found 'when two stars are not connected by space at all'. He then referred to a specific astrophysical phenomenon: 'A big enough and concentrated enough star would, I understand, separate itself out from our space altogether.' The predicament is 'too non-Euclidean' not simply because the curvature of spacetime is so extreme, but because such a condition would undermine the coherence of the physical world. Or so Empson's source, Eddington, believed.

In a collection of his seminal papers on stellar structure and evolution, *The Internal Constitution of the Stars* (1926), Eddington explained that giant stars had a very low density. Betelgeuse, for example, has a volume around fifty million times that of the Sun, but its mass, calculated from its brightness, is only ten or a hundred times greater than the Sun's. In a playful aside Eddington noted the 'rather interesting' implications

of Einstein's theory of gravitation with respect to a hypothetical giant star with high density:

Firstly, the force of gravitation would be so great that light would be unable to escape from it, the rays falling back to the star like a stone to the earth. Secondly, the red-shift of the spectral lines would be so great that the spectrum would be shifted out of existence. Thirdly, the mass would produce so much curvature of the space-time metric that space would close up round the star, leaving us outside (i.e. nowhere).⁴

Aware that his 'more conservative readers' might find such a conclusion 'ultra-modern', Eddington cited the Newtonian example of a large dense star, described by Pierre-Simon Laplace in the 1790s:

A luminous star, of the same density as the earth, and whose diameter should be two hundred and fifty times larger than that of the sun, would not, in consequence of its attraction, allow any of its rays to arrive at us; it is therefore possible that the largest luminous bodies in the universe may, through this cause, be invisible.⁵

Repeating the argument in a collection of popular lectures, *Stars and Atoms* (1927), Eddington commented that, '[e]xcept for the last consideration, it seems a pity that the density of Betelgeuse is so low'.⁶ Happy with the concept of invisible dense bodies in the universe, he could not tolerate the prospect of Einstein's spacetime producing such a bizarre condition.

Empson liked to push his love affairs beyond the limits of physical theory, using the dramatic implications of Einstein's theory to explore extreme psychological or social conditions. In 'Camping Out' he had two lovers travel faster than light, explaining in a commentary that 'on the Einstein Theory this would crack up the whole of space. The idea is that a great enough ecstasy can make the common world unreal'.⁷ 'Letter I' also uses Einstein to make the common world unreal but this time the thwarting of ecstasy leaves the lover completely cut off from the rest of the universe – including the object of his affections. 'Where is that darkness that gives light its place? / Or where such darkness as would hide your face?' There can be no flirtatious glances beneath the stars: communication, never mind intimacy, has completely broken down.

The laws of physics are not responsible for this situation; they have merely been used as a description of the world that can be driven into an unfortunate extreme when applied metaphorically to human beings. Knowing what Eddington said about Einstein's theory of gravitation helps us grasp the non-Euclidean predicament, but verse three remains a mystery. Its key idea is drawn not from astronomy but from an influential study of ancient religion and philosophy, written by one of Desmond Lee's lecturers. In his note to the poem Empson explained that he had conceived the radically separated stars in terms of

two people without ideas or society in common, hence with no 'physics' between them in what F.M. Cornford said was the primitive sense of the word. Lacking a common life-blood shared from one totem (showman because tragic hero) they are connected by no idea whose name is derived from 'physics'.⁸

There is both irony and melodrama in Empson's combination of an idea from Eddington with a reference to Francis Cornford's work. The poem's dense core is compacted from course books and extracurricular reading that Empson, Lee and their associates would have spent pleasurable hours discussing; it uses shared reference points to bewail a lack of shared sense or society between them.

In packing the allusions so densely Empson risks losing readers who do not themselves share this knowledge, closing the poem itself up in a world of its own. But the context of publication helps to make this risk an engaging part of the poem's

meaning, raising questions about community and communication rather than undermining the poetry completely. 'Letter I' was initially published (with just these three verses) in the first number of *Experiment*, a Cambridge undergraduate magazine run by a group of students whose interests crossed the full range of arts and sciences.⁹ Appreciative (and often bewildered) readers enjoyed the challenge of following Empson's allusive, playful arguments in verse, while others chose to place themselves outside its non-Euclidean curves. Commentators in other Cambridge student magazines noted the pretensions of *Experiment* contributors – describing them as 'lamentably clever young gentlemen talking claptrap', who went about drinking 'foul drinks with foreign names, for the sake of being drunk in Russian rather than tight on beer'.¹⁰ Today's readers also have a choice, for in his subsequent collections Empson was careful to provide notes to his poems, wanting their puzzles to be accessible to any curious reader.¹¹

The whole question of shared knowledge and experience underpins Empson's literary engagement with science, and the common lifeblood theme enables 'Letter I' to move beyond a superficial analogy between stars and people, drawing Eddington's comments on some strange features of current cosmology into a perplexed account of intimacy in the 1920s. To make sense of the way 'Letter I' uses Eddington's hypothetical large dense star in verse three and the white dwarf in verse four, we need to understand something of Francis Cornford's work and its bearing on undergraduate life in Cambridge during the early twentieth century.

Francis Macdonald Cornford (1874–1943) taught classics during a period of curriculum upheaval at Cambridge. Towards the end of the nineteenth century and into the 1900s, reformers struggled to reinvigorate subject areas where the former brilliance of Cambridge was starting to wane – especially mathematics and classics.¹² Addressing the newly founded Cambridge Classical Society in 1903, Cornford championed his subject by comparing it to cosmology: 'as the philosophy of every new age puts a fresh and original construction on the universe, so in the classics scholarship finds a perennial object for ever fresh and original interpretation'.¹³ But what kind of knowledge could classical study offer to compete with the discoveries made through ever more powerful telescopes? The astronomers might study distant objects, but their findings had long been implicated in controversy over man's place in the universe and the existence of a creator, and their eclipse expeditions to far-flung reaches of the British empire were frequently in the newspapers. Cornford's successor to the Laurence Chair of Ancient Philosophy at Cambridge identified the central theme in this reinvigoration of classical study: a concern with the 'groundwork of current conceptions shared by all the men of any given culture and never mentioned because it is taken for granted as obvious'.¹⁴ To study the classics meant investigating the world in which ancient thinkers lived, uncovering the conceptions they took for granted. Yet in his teaching Cornford was at pains to emphasise the 'fresh and original interpretation' of that world. If astronomy could tell us about the universe, studying the classics might help students to become aware of their own 'current conceptions', taken-for-granted assumptions about everything from society to the universe itself. Cornford was particularly concerned about the mental habits among Cambridge academics, and in 1908 published a satire on university life. This included the recommendation that

'books be kept from the young' by making them 'so dry as to offer no temptation' and by storing them 'in such a way that no one can find them without several years' training'.¹⁵ Writing about ancient philosophy and society in his own books, Cornford made his readers self-conscious about the fabric of their own life and thought. The appeal of this material to a hungry young polymath, struggling to find a larger frame for his own romantic and social dilemmas, would have been irresistible.

In October 1928, around the time Empson started composing the Letter poems, Desmond Lee began studying for Part II of the Cambridge classics tripos. He opted to specialise in philosophy, Cornford's area of expertise, and went on to attain a first class degree with special merit for his work in this area. In his book *From Religion to Philosophy* (1912), which Lee would have absorbed at an early stage of his studies, Cornford argued that early Greek speculation about the universe originated in tribal experience of totemism. The concept of *physis*, a material and divine substance underlying the natural and super-natural world, was the key to this continuity between magical, religious and philosophical thought. As man's approach to the world had shifted from being 'active and emotional' to 'intellectual and speculative', philosophical enquiry had developed out of religious practice; but both religion and philosophy were concerned with this same fundamental substance. Cornford traced the origin of *physis* back to the 'primitive sense of constant and continuous identity' that bonded the members of a tribe to each other and to their totem. *Physis*, the vital fluid, was at once the shared blood of the kin-group and the 'social fact' of their collective consciousness. Acknowledging the difficulty that modern readers might have in comprehending this, Cornford offered the example of the 'Australian savage', whose 'belief that he is a kangaroo is so unquestioned that he has no need to pretend that he is one, or to induce a kangaroo to enter into him and possess him for the nonce; all he has to do is to be a kangaroo by behaving as one'.¹⁶

The early twentieth century offered numerous alternatives to behaving like a kangaroo. Individuals wishing to connect their lives to a universal force might take up spiritualism, or join a movement such as the Order of Woodcraft Chivalry whose activities ranged from gymnosophy to totemism. One could recapitulate primitive experience by dancing naked in the forest, or follow the Futurists in celebrating the speed, noise and glare of modern life. Popular physics books in the 1920s and 30s fuelled what W. H. Auden described as a 'Universal-Complex sensibility', with their various claims about the relations between mind and matter.¹⁷ Empson's literary studies led him to take a different approach: using love affairs to try and make sense of the universe, and vice versa. In doing so he was consciously imitating John Donne, whose poetry he admired for its rebellious tendency to give individuals in love a universe of their own, setting them up as rivals to Christ. Empson's interpretation of this theme in Donne's poetry links lovers to the totem described by Cornford:

The assertion that somebody is the whole world, or that their death will destroy the whole world, is always coming up in Donne's work . . . It is an ancient belief that the king or emperor has a magical effect on the country he rules; . . . In a sense he *is* everything, because he is magically connected to everything. . . . Christ is the Logos of theology, that is, he is the underlying reason which keeps the universe obeying its laws, and he was also an individual man. And by his death he altered the conditions of the whole world. So what Donne says about his heroines was seriously believed about Christ.¹⁸ Donne, as Empson saw it, was 'stealing fire from the two most sacred sources, royalty and religion, and the effect is to say with insolent force that he cares

about nothing but the love-affair that he describes’.

Cornford’s lifeblood theme gave Empson a way to generalise the figure of Christ, making him one in a long line of tragic heroes stretching back to the tribal totem. The third number of *Experiment* magazine included Empson’s ‘Letter III’ and a piece of criti-cism analysing George Herbert’s ‘The Sacrifice’, exploring the earlier poet’s engagement with the darker side of Christian doctrine – the ‘vindictive terrors of the sacrificial idea’ that Empson saw as inextricably bound up with ‘the loving kindness of Jesus’. The young critic had enormous respect for Herbert’s presentation of ‘the complete Christ’, a figure he described in terms that connect closely with his note to ‘Letter I’:

scape-goat and tragic hero; loved because hated; hated because godlike; freeing from torture because tortured; torturing his torturers because all-merciful; source of all strength to men because by accepting he exaggerates their weakness; and, because outcast, creating the possibility of society.¹⁹

Christ, like the totem, is described as a ‘tragic hero’ whose function is connecting men to each other. Empson elaborated the link between these two figures in *Some Versions of Pastoral* (1935), a book exploring different literary forms of the outcast figure who makes society possible. According to Cornford, he explained, ‘the primitive Greeks invented Nature by throwing out onto the universe the idea of a common life-blood; the living force that made natural events follow reasonable laws, and in particular made the crops grow, was identified with the blood which made the members of the tribe into a unity and which they shared with their totem’.²⁰ Following Cornford’s use of the term *physis* Empson suggested that there was an ancient connection between the work of the physicist and that of the physician – each is concerned, in his own way, with the underlying order of things. He went on to discuss literary examples that treated the blood of Christ as a living force of this kind. Christian doctrine lent itself to such pantheistic interpretations, he explained, because ‘the Logos had been formulated as the underlying Reason of the universe and was also the Christ who had saved man by shedding his blood and sharing it in the Com-munion’. Empson was particularly attracted to Donne’s poetry because he found it full of examples where individual lovers took on the function of Christ, ‘the sacrificial cult-hero’, acting as Logos for a universe of their own.²¹

‘Letter I’ condenses this cluster of associations into a few short lines, making a last-ditch appeal for contact of any kind. ‘Only, have we sense, common-sense in common’, the speaker asks, offering the hopeful example of a totemic ‘tribe whose life-blood is our sac-rament’. The lifeblood of the tribe is, following Cornford, a substance at once physical and metaphysical, and there is a witty argument for seduction embedded in the line ‘Physics or metaphysics for your showman’: in a totemic situation shared metaphysical convictions might automatically entail shared bodily fluids. But the opportunity for seduction by philosophy or any other means has been lost and the speaker is now banished, with no physicist or physician to heal his pain or overcome his separation from the rest of the world. As in previous verses, the speaker’s position has shifted during the process of argument and elaboration. In attempting to win affection he has become something of a ‘showman’ himself, and in his banishment he is taking on the role of tragic hero or scapegoat, the one whose exclusion makes normal society possible.

Empson took from Donne a working definition of metaphysical poetry, in which the

individual person is made to stand for everything. The metaphysical poet, he explained, believes 'that a love-affair is the fundamental means of understanding the world, or that the real purpose of building any system of knowledge is to understand love'. In his essay 'Donne the space man' Empson touched on the darker side of the space exploration that this type of poetry entailed: lovers inhabiting a separate planet stood to gain independence from terrestrial authority but they also risked isolation; the 'interplanetary spaces', he observed with feeling, 'are inherently lonely and ill-provided'.²² Following Donne's metaphysical practice in his own poems, Empson discovered that interstellar loneliness could be even more intense in Einstein's universe.

By the time Empson published his *Poems* in 1935, 'Letter I' had gained a fourth verse pursuing the theme of separation in space:

Our jovial sun, if he avoids exploding
(These times are critical), will cease to
grin, Will lose your circumambient
foreboding; Loose the full radiance his
mass can win
While packed with mass holds all that
radiance in; Flame far too hot not to seem
utter cold
And hide a tumult never to be told.

As he explained in his note to the poem, this builds on the fate of the massive dense star by describing 'a similar failure of communication which may in the end happen to the sun'. Referring back to the start of the poem, 'your circumambient foreboding' denotes 'the empty space round him which connects us to him and which you fear'; Empson's line in the poem invests the space with human feeling that recalls totemic or pantheistic power, only to remind us that the dying Sun's separation from space is cutting off any such intimate connection.

In *Stars and Atoms* Eddington introduced the Companion of Sirius as an example of a very hot star that gave out only a feeble light because it was so small: a white dwarf. Since the star's mass was close to that of the Sun, this meant that its matter had to be very densely packed indeed; the high temperature made this possible. But as the star ran out of fuel its temperature must fall, and the star must therefore expand to reach a lower density. Eddington described the 'predicament' faced by such a star:

Energy will be required in order to force out the material against gravity. Where is this energy to come from? An ordinary star has not enough heat energy inside it to be able to expand against gravitation to this extent; and the white dwarf can scarcely be supposed to have had sufficient foresight to make special provision for this remote demand. Thus the star may be in an awkward predicament – it will be losing heat continually *but will not have enough energy to cool down*.

Eddington reported the very latest work from his colleague Ralph Fowler, who had applied quantum theory to the behaviour of atoms inside the white dwarf in order to solve its predicament. Capturing the excitement of the years during which astrophysics

came into its own, Eddington remarked that the white dwarf had become 'a happy hunting ground for the most revolutionary developments of theoretical physics'. Once the classical conceptions were abandoned, he explained, it was possible to conceive of particles – or stars – that could no longer radiate but still had plenty of kinetic energy. This permitted a neater ending for the white dwarf:

If you measure temperature by radiating power its temperature is absolute zero, since the radiation is nil; if you measure temperature by the average speed of molecules its temperature is the highest attainable by matter. The final fate of the white dwarf is to become at the same time the hottest and the coldest matter in the universe. Our difficulty is doubly solved. Because the star is intensely hot it has enough energy to cool down if it wants to; because it is so intensely cold it has stopped radiating and no longer wants to grow any colder.²³

When it reached this state any star would become invisible; Eddington concluded that this was the fate of every white dwarf and perhaps every star.

Empson carefully applied this conclusion to his own Sun in the poem, with one crucial addition: the white dwarf's great density and lack of radiating light reminded him of the hypothetical massive dense star Eddington had described earlier and which he had himself used in the previous verse. The two conditions are linked by Empson in his use of the word 'predicament' in verse three, drawn from Eddington's description of the white dwarf; and by his reference in verse four to the loss of 'circumambient foreboding' – the awe-inspiring space around the Sun. It is this connection that makes 'Letter I' appear to run ahead of astrophysical theory and produce a black hole between 1928 and 1935.

During the period of the poem's completion British astronomy witnessed a sharp debate on the structure of white dwarf stars. In January 1935, at a meeting of the Royal Astronomical Society, the young mathematician Subramanyan Chandrasekhar presented calculations to prove that no white dwarf could have a mass greater than 1.4 times that of the Sun. Stars over this limiting mass appeared to have a peculiar fate in store for them: they would carry on contracting beyond the point at which the white dwarf found stability.²⁴ Eddington dismissed this strange result as an absurdity, for it appeared to undermine the prospect of a well ordered universe; such a verdict from a leading authority within the astronomical community helped to delay research into the gravitational collapse of massive dense stars.

What kind of knowledge does 'Letter I' produce? Using metaphors from modern cosmology, Empson discovered that lovers in the 1920s faced even greater difficulties than Donne and his lady. Caring for nothing but the love affair led to a pathological separation from the rest of the universe, suggesting that a compromise between intimacy and society would be more successful. Empson went on to pursue this alternative in 'Letter IV', again using an example from modern cosmology to analogise human affairs. In addition, 'Letter I' uses love to test the limits of Einstein's universe, pursuing an extreme condition dismissed by Eddington as absurd. Loving faster than light, Empson was constrained neither by the institutional culture of British astronomy, nor by the laws of physics. His poem does not strictly predict a black hole, but in pursuing an obsessive love affair to its extreme it takes the hypothetical astronomical extreme seriously, opening up the possibility of a romantic black hole long before any other imaginative author.

I am indebted to John Haffenden for his generous scholarship; I have drawn heavily on his editions of *The Complete Poems of William Empson* and *Empson's Essays on*

Renaissance Literature, Vol. I: *Donne and the New Philosophy*, and from the first volume of his biography, *William Empson: Among the Mandarins*. I am very grateful also to Gillian Beer for supervision and to Michael Whitworth and Ian Patterson for examination of my PhD thesis, in which this material first appeared. Jeff Mackoviak first drew my attention to the apparent singularity in 'Letter I'. Doctoral study on this topic was funded by the Arts and Humanities Research Board and postdoctoral research on Empson and Eddington was supported by Homerton College, Cambridge. An early version of this paper was given as a lecture at the Royal Institution on 25 June 2001.

NOTES

1. K. S. Thorne: 'The search for black holes', *Scientific American*, 1974, **231**, (6), 32–43.
2. W. Empson: 'Letter I', in *The Complete Poems of William Empson*, (ed. John Haffenden), 31; 2000, London, Allen Lane.
3. John Haffenden supplies details of this story in *The Complete Poems of William Empson*, p. 212 (see Note 2).
4. A. S. Eddington: *The Internal Constitution of the Stars*, 6; 1926, Cambridge, Cambridge University Press. Kip Thorne comments on Eddington's 'whimsical approach' in this passage, describing the third claim about space closing up round the star as 'typical Eddington hyperbole' (K. S. Thorne: *Black Holes and Time Warps: Einstein's Outrageous Legacy*, 134; 1994, New York, NY, Norton.)
5. P.-S. Laplace: *Système du Monde*, cited in A. S. Eddington: *The Internal Constitution of the Stars*, p. 6 (see Note 4).
6. A. S. Eddington: *Stars and Atoms*, 83; 1927, Oxford, Clarendon Press.
7. W. Empson: *The Complete Poems*, p. 205 (see Note 2).
8. W. Empson: *The Complete Poems*, p. 211 (see Note 2).
9. The magazine lasted from 1928 to 1931 and was run by a group that included Empson, Jacob Bronowski, pioneering documentary film-maker Humphrey Jennings, poet and critic Hugh Sykes (Davies), and Viscount Ennismore, future Governor-General of Ghana. See J. Harding: 'Experiment in Cambridge: "A manifesto of young England"', *Cambridge Quarterly*, 1998, **27**, 287–309; K. Price: 'Finite but unbounded: *Experiment* magazine, Cambridge, England, 1928–1931', *Jacket Magazine*, 2002, **20**, jacketmagazine.com/20/price-expe.html.
10. TW: 'Nothing venture', *Granta*, 1929, 7 June, 531; Mario: 'Book reviews', *Cambridge Gownsmen*, 1929, 30 November, 22.
11. John Haffenden's 2000 edition (see Note 2) provides today's readers with a wealth of additional material to support interpretation of the poems' engagement with themes from science, religion and numerous other sources.
12. G. Johnson: *University Politics: F.M. Cornford's Cambridge and His Advice to the Young Academic Politician*, 56; 1994, Cambridge, Cambridge University Press.
13. Cornford, as cited in G. Johnson: *University Politics*, p. 63 (see Note 12).
14. W. K. C. Guthrie, as cited in G. Johnson: *University Politics*, p. 4 (see Note 12).
15. F. M. Cornford: *Microcosmographia Academica: Being a Guide for the Young Academic Politician*; 1908, Cambridge, Bowes.
16. F. M. Cornford: *From Religion to Philosophy: A Study in the Origins of Western Speculation*, vii–x, 77–78; 1912, London, E. Arnold. This work formed part of a

wider investigation into the links between religion, philosophy and literature in ancient society, a project that was initiated by Jane Harrison and included contributions from Gilbert Murray. The group are sometimes referred to as the 'Cambridge Ritualists'.

17. W. H. Auden: 'Letter to Lord Byron', in W. H. Auden and L. MacNeice: *Letters from Iceland*; 1937, London, Faber.
18. Unpublished notes, quoted in W. Empson: *Essays on Renaissance Literature*, (ed. John Haffenden), Vol. I: *Donne and the New Philosophy*, 4; 1993, Cambridge, Cambridge University Press.
19. W. Empson: 'The Sacrifice', *Experiment*, 1929, **3**, 41–44, 44. The analysis of Herbert's poem subsequently appeared in Empson's first book of criticism, *Seven Types of Ambiguity* (1930).
20. W. Empson: *Some Versions of Pastoral*, 67–68; 1995, London, Penguin.
21. W. Empson: *Some Versions of Pastoral*, pp. 68, 70 (see Note 20).
22. W. Empson: *The Complete Poems*, pp. 4, 84 (see Note 2).
23. A. S. Eddington: *Stars and Atoms*, pp. 124, 125, 127 (see Note 6).
24. Accounts of Chandrasekhar's work on the limiting mass for white dwarfs can be found in K. S. Thorne: *Black Holes and Time Warps*, Chapter 4 (see Note 4); K. C. Wali: *Chandra: A Biography of S. Chandrasekhar*, Chapter 5; 1991, Chicago, University of Chicago Press; A. I. Miller: *Empire of the Stars: Friendship, Obsession and Betrayal in the Quest for Black Holes*; 2005, London, Little, Brown.